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A simple and inexpensive self-registering auxanometer.

HERMON C. BUMPUS.

(WITH PLATE VII.)

Wishing to try a few experiments on the growth of plants, and not having the ordinary self-registering apparatus used by Pfeffer, Baranetzky and others, I was led to improvise the instrument which is figured in plate VII. For a support for both apparatus and plant, I found a broad window-sill was quite free from any appreciable jar.

The auxanometer proper (fig. 4) is very similar to that figured by Dr. Goodale, consisting of an horizontal arm supported to the casing by the bracket *v*, and bearing two strips of tin, notched at *m*, where rests the axis of the spool, *o*, over which the thread, *p*, is allowed to pass twice, being attached to the plant at *r* by means of a small needle thrust through the leaf, and kept taut by the light weight *p'*.

The indicator, *l*, is easily made by joining two or three straws, as recommended by Prof. Bessey, which may be found at any apothecary's. The terminal portion may then be made into a style by carefully splitting back a sliver until it makes an angle of about 30° with its former position, and the tip, nicely sharpened, again bent abruptly at an angle of nearly 90°. This long arm, *l*, should be balanced by a movable weight at *n*. The axis, *m*, should be rather long, that the arm may swing, if necessary, in several parallel planes.

The registering surface (figs. 2 and 3) is a piece of flat glass which has been held over a burning rag previously saturated with turpentine. The smoked plate, *d*, is held by a frame, *c*, which is free to move, in obedience to the weight *u*, in the same plane as the arm *l*, by means of the wheels *a*, *a*, the axes of which are held by pieces of notched tin at *b*, *b*, bearings which have but little friction.

By moving the axis at *m* the style may be gently placed against the smoked glass, and as the plant grows an arc will be drawn from top to bottom, or if the weight *u* is allowed to act a line will be drawn from right to left. The motion in obedience to the weight may be made regularly intermittent, and as a result we shall have a zigzag line, the distance between every two angles of which signifies a regular interval.

The interrupted movement may be brought about by having a strip, *e*, bearing at regular intervals round wire nails, attached to the lower portion of the carriage.

One of these nails is held for a certain time by the hook *h* (fig. 5), which is attached to the strip *f* (figs. 5, 2, 1), which moves about the pivot *g* (fig. 1). Finally, when *h* is elevated, *h'*, which is attached to a similar and parallel rod and moves with *f* about *g*, catches the next succeeding nail, and holds it a regular period, before allowing it to reach *h*. A short horizontal line is thus drawn by the style at *w* (fig. 2).

The elevating and depressing of the escapement at *h h'* is brought about by attaching the works of one of the cheap nickel-plated clocks, which will run when held in any position, to a board, *k* (figs. 2 and 3). In place of the "long hand" there is attached a crank which will play through the slot *i* (fig. 5). As the post turns the crank toward XII o'clock *h* will be elevated, and at VI o'clock, thirty minutes later, *h'* will be depressed to its greatest, one nail thus sliding by every half hour. The escapement hooks may be easily cut out of two pieces of tin.

If the arm does not swing parallel with the smoked surface, change the screws at *x* (fig. 3).

One recommendation the apparatus has is its inexpensiveness, costing, with the clock, if one is his own carpenter, not more than three dollars. Another is the ease with which the records for several half hours may be compared, and the little labor necessary to prepare permanent records, by simply placing the glass on a piece of "blue print" paper and exposing to sunlight.

A registering auxanometer.

CHARLES R. BARNES.

(WITH PLATE VIII.)

In January last my class in physiology had occasion to study the rate of growth of seedlings under various conditions. I needed an instrument to keep a continuous record of their growth, and Germany was too far away to send for one. With the help of the students in the mechanic shop I arranged and constructed the instrument here described. It is comparatively simple and inexpensive, and requires no

work which can not be done by a turner and a machinist, at slight cost.

R, plate VIII, is a cylinder of pattern pine, twelve inches long and three in diameter; centered in its ends are two pieces of brass rod about three-eighths of an inch in diameter, the lower and longer of which, *h*, is coned on its free end and carries about its middle a drum, *f*. This is a silk-spool bored out a little. The lower axle of the cylinder rests upon a piece of glass hollowed to receive its point, and the upper passes through a small plate of brass, *z*, (figs. *A* and *D*), bored to fit it smoothly and screwed to a light frame of wood, $\frac{3}{16} \times 2$. The upper or cross-piece is seen at *D*, with ends dovetailed to fit the side pieces. This top piece can be lifted out so as to allow the removal of the cylinder.

Around the drum, *f*, passes a cord, over the pulley, *r*, to the weight, *m*. The pulley is made of a section of a spool with a groove filed around it, revolving on a glass rod. By the fall of the weight, *m*, the cylinder would rotate continuously were it not for twelve equidistant pins, *o o*, which engage with the armature, *p*, of an electro-magnet, *e*. The pins are wire-nails, driven in and cut off, and in a second instrument were placed radially around the lower end of the cylinder so as to use a straight armature.

The electro-magnet is one of the simplest form and can be had of dealers in electrical apparatus. I first adapted a relay instrument to this use, but afterwards wound a magnet with number twenty-four silk-covered wire and made it a permanent part of the apparatus. The magnet is connected, as shown in the figure, with a battery, *W*, through the clock, *Q*, so arranged by tying the striking wheel as to strike but once each hour. One wire from the battery (the LeClanché cell used for door-bells) is soldered to the hammer arm, *v*. Its continuation is soldered to a piece of watch-spring, *d*, so fixed that the hammer, *v*, as it draws back to strike will come in contact with it.

The tripod lamp-stand, *g*, carries an arm, *u*, shaped like a tuning-fork, between whose arms the wheel, *a b*, (seen in section at *B*), revolves on a wire axle pointed to fit into holes in the arms. This axle can be taken from the works of an old clock. The wheel *B* is of wood and can be made by the turner who makes the cylinder. It is double, having a large part, *b*, and small part, *a*. This wheel must be so balanced that it will stop at any point indifferently. If not turned accurately counterpoises of flat bits of metal can be attached

on the light side by gummed paper. From the weight, *y*, the thread *c* passes over *b*, in the groove cut for it, and carries *t*, the recording needle. This, as shown in *E*, is a common needle heated and bent, and inserted in a block of lead which is grooved for the supporting threads. The point of the needle should be blunted, and the sides filed flat to prevent turning. Of course *t* and *y* must balance each other.

From the plant *u* around whose tip it is looped, the thread *k* takes a complete turn around *a* and is just kept taut by the weight *s*.

The apparatus, spread out in the plate, can be compactly arranged on a base-board 14 × 18 inches, which is supported by four leveling screws, *l l*. These are ordinary long wood screws with the points rounded. If desired a strip of metal can be soldered in the slits, so that they can be turned with the fingers.

When ready to operate, the cylinder *R* must be smoothly covered with a sheet of glazed paper, the edges gummed and overlapping in such direction as not to catch the needle point. Smoke the paper evenly over a *turpentine* flame. Camphor smoke adheres too firmly. Having arranged the threads *c* and *k*, twist *c* so as to make the point of the needle bear against the smoked paper. The growth of the plant *u* will, as the slack of *k* is taken up by the weight of *s*, cause the wheel to revolve and will raise *t* as many times as far as the plant grows, as the diameter of *b* divided by the diameter of *a*. While *R* remains still, the lifting of *t* will make a vertical mark. But at each hour the hammer of the clock touching *d* makes *c* a magnet, which draws up the armature, *p*, releasing the pin *o* and allowing the cylinder to revolve. The armature is released the next instant and returns in time to stop the next pin. By this partial revolution the needle makes a horizontal line. The record of a sunflower from 3 P. M. to near 11 is shown in *S*.

When the needle has risen to the top of the cylinder the paper may be slit along the line of union, removed and immersed in a solution of white shellac in alcohol. When dry the soot can not be rubbed off and the record may be studied and compared with others.

The total cost of the apparatus, including the clock, will be from $10 to $15, according to the amount of work put upon it. The results are entirely satisfactory.

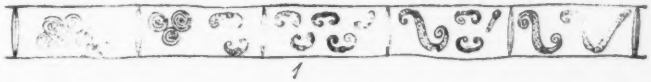
Spirogyra under shock.

STANLEY COULTER.

At the December meeting of the Indiana Academy of Science I presented a paper showing a peculiar action of the young chlorophyll band of *Spirogyra quinina* Kütz. under shock, which indicated its extreme sensitiveness and very considerable tension. The question arose as to whether this action was constant, or merely the result of peculiar conditions. If the latter, what were those conditions?

The observations upon which the conclusions of the paper were based were briefly as follows:

Certain vigorous vegetative filaments, being cut with a scalpel for the purpose of reducing their length, showed that the chlorophyll band was broken up in the cells adjacent to the cut. This breaking up seemed to have followed a somewhat definite plan. In the cells immediately adjoining the cut the band was broken into twice as many parts as there were turns of the band, and these parts were coiled closely



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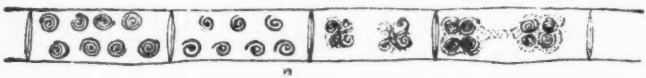
about a darker colored center, which appeared in no wise different from the nodules. As the distance from the laceration increased the closeness of the coil diminished, but the number of parts was still double the number of turns in the cell. Still further from the cut, instead of the simple coil, the band on either side of the "darker spot" broke away from its surroundings, and showed a marked tendency to coil about this "dark spot" as a center. In cells still further removed from the wound, while the band was not completely broken up, it never failed to show a strong tendency on the part of certain regions of the band to gather about certain definite centers, and these centers were always twice the number of turns in the cell. However sharp the instrument, however deft the stroke, the chlorophyll band never failed to respond to the laceration through from eight to ten cells in both directions. The only peculiarities observed in the specimens examined were:

1. The band rarely, if ever, filled the entire cell length.
2. The edges of the band were entire—not "wrinkled and crenulated."

3. The band was almost entirely destitute of nodules.

4. The specimens were collected in November and December.

The fact of the parts of the band coiling, or showing a



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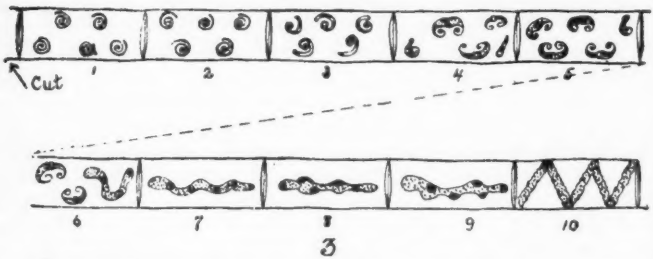
tendency to coil, about certain points suggested the possibility of these points being "centers of growth."[1] Although having very much the appearance of nodules, a careful examination seems to prove them nothing more than closely compacted, well defined masses of chlorophyll bodies. The immediate response to laceration, and the comparatively large number of cells through which the action took place, led to the conclusion that the band was extremely sensitive, while the coiling of its parts gave evidence of a very considerable degree of tension. Pressure, or other forms of mechanical violence than cutting, disintegrated the band completely, and never gave the results indicated above.

Figs. 1, 2 and 3 will, perhaps, illustrate the results more clearly than the description. The figures are drawn simply



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to illustrate the appearances, and are not drawn to any scale.

In Fig. 1 is shown the only case in which, in a series of some hundreds of slides, the nucleus was seen after the band was broken up.

Fig. 2 gives a case in which there were four turns of the band to the cell, and also shows a peculiar condition in cells 3 and 4, in which the protoplasm is gathered about the coils as indicated by the lighter shading, and seems to bind them together.

[1]Cf. Sachs, 2d Eng. ed., p. 48.

Fig. 3 shows a series of ten cells immediately adjoining the cut, and illustrates fairly well all the points indicated above. In all the figures the cut is at the left, and the darker shading represents the apparent centers.

A series of experiments made in January and February verified the results upon which the paper was based. The effect of other shocks was then tried, with the following results:

Filaments plunged into boiling water showed a large distension of the cell, accompanied by disintegration and diffusion of the band; a result presumably caused by the expansion of the cell contents by the heat, although possibly the water may have penetrated the cell walls.

Filaments were then frozen in water by an improvised ice-cream freezer, and were kept packed in ice for twenty-four hours. No change was shown, if we except the evident checking of all vegetative processes. It is possible that a greater degree of cold might have produced different results.

Filaments were also subjected to an electric shock; but in every case, even with the feeblest current I was able to secure, the result was the utter destruction of the filament.

Filaments were then subjected to the action of various dilute acids. In all these cases the entire protoplasmic contents of the cell were contracted, involving, of course, the band. Brine gave similar results. In none of the cases was there even an approach to the forms shown above except in the case of brine, which, when very strong, would sometimes give forms resembling those shown in cells 7, 8 and 9 of Fig.

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3. [See Fig. 4, which shows general action of acids and brine.]

At the close of these experiments the cause of this action was still problematical. In March, however, the pond from which all my Spirogyra had been collected failed to honor my demands. Zygnema had taken its place completely, and I was at a loss for further material. Some unused portions of previous collections had been thrown into a tub, and in this tub was found a new supply. These filaments, though evidently Spirogyra quinina, surprised me by failing to respond to laceration as readily and uniformly as I could wish. The band was more wrinkled, abounded in nodules, and

uniformly stretched from end to end of the cell. Thinking I had not secured growing tips, I cultivated a small lot in a jar; but even then, while the results were occasionally satisfactory, they were far from constant, and were secured only after a laceration that would have completely disintegrated the band in my first experiments. Material collected from other places also failed to produce the results expected. This pointed to some special local condition as the cause of the peculiar action of the band. Investigation showed the following facts:

The pond was formed by the waste water of a blast furnace. Its water was always warm. Its sandy bottom was warmer than the water. In the coldest weather it never froze. (This last fact is given upon the authority of employés of the furnace.) Thermometric tests showed that when the temperature of the air was from 16° to 20° F. that of the water of the pond was from 68° to 76° F., while that of the bottom was from four to seven degrees higher still. The

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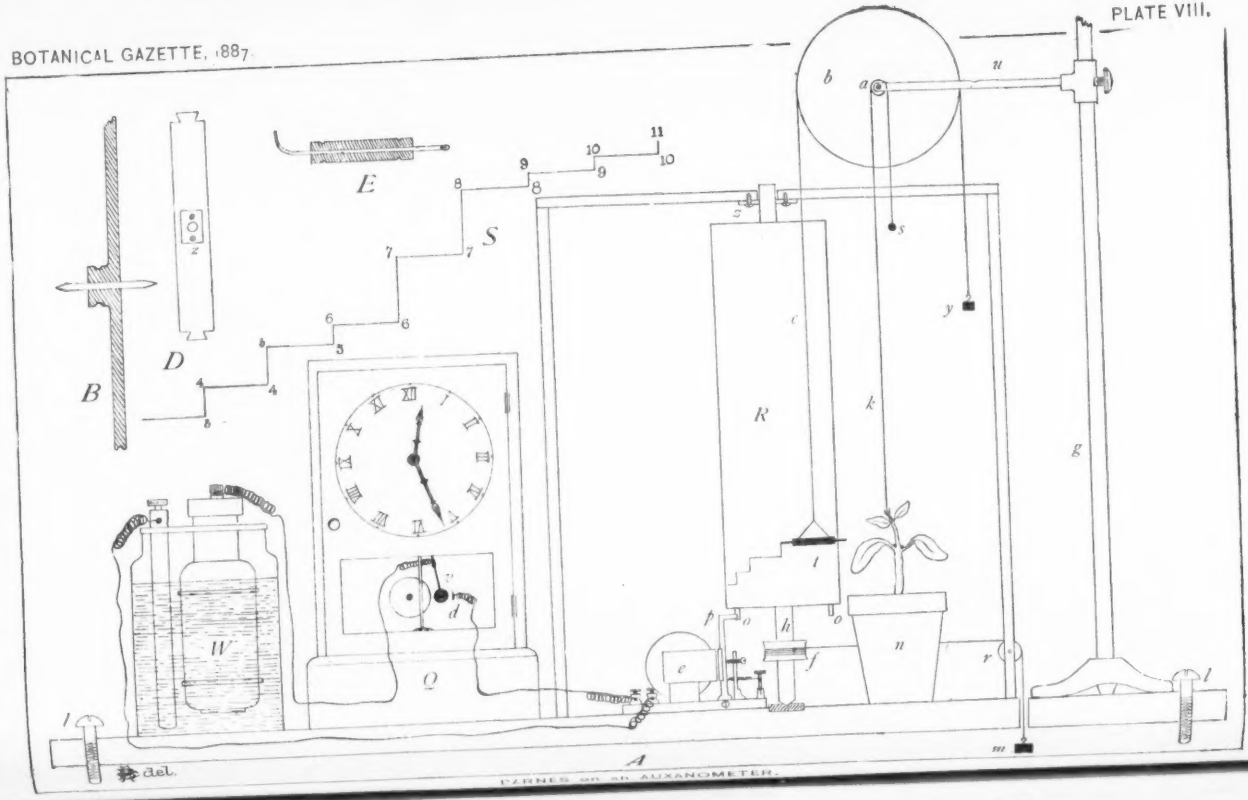
fact that there was no time during the winter in which I was not able to collect Spirogyra or allied forms, and the collection of Zannichellia palustris, var. pedunculata, in full fruit in March [ante, p. 109], lead me to a ready belief of the statement that it never freezes.

This comparatively high and even temperature seemed, then, to be the lacking condition in the environment of the filaments grown in the tub. After numerous trials, I succeeded, by the use of a series of water baths, in securing a temperature of from 70° to 90° F. which was reasonably constant. I then cultivated some of my "unresponsive" Spirogyra with this added condition. It grew with astonishing rapidity. Examining the filaments thus grown, I found the exact conditions noted in those collected from the blast furnace pond, and a repetition of the experiments produced the same results.

The sensitiveness and tension of the young chlorophyll band noted in the paper read before the Academy may therefore, I think, be safely attributed to the influence of a comparatively high and constant temperature. The uniform results obtained in numerous repetitions of these experiments



PARNES on an AUXANOMETER.

lead me to the conclusion that this peculiar action will always be found under the above conditions.

A further fact observed during these studies may here be noted, though not connected with the main point of this article. In many cases one or more cells in a filament may be found with two bands, while the cells on either side have only a single band (Fig. 5). The frequency of occurrence of this condition would seem to indicate that the "number of bands" in a cell is an unreliable specific character.

Notes on Umbelliferæ of E. United States. VI.

JOHN M. COULTER AND J. N. ROSE.

(WITH PLATE IX.)

PIMPINELLA Linn.—Fruit oblong to ovate, flattened laterally: carpel with 5 equal slender primary ribs (sometimes almost obsolete): oil-ducts 2-6 in the intervals, 4-8 on the commissural side: seed-section somewhat dorsally flattened, the face from slightly convex to more or less concave: stylopodium cushion-like or conical (figs. 69–74).—Glabrous perennials, with ternately or pinnately compound leaves, involucre and involucels scanty or none, and white or yellow flowers.[1]

1. **P. integerrima** Benth. & Hook. Gen. Pl. i. 894. Glaucous, 1-3 feet high, branching: leaves 2 to 3-ternately compound; leaflets lanceolate to ovate, entire: flowers yellow: fruit broadly oblong, 2 lines long: oil-ducts mostly 3 in the intervals, 4 on the commissural side: seed-face almost flat:

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[1] Our two western species are:

P. apiodora Gray, of the Pacific slope, from Northern California and Nevada to Oregon, of which no good fruit has been collected, and the very distinct new species from Southern California.

P. Parishii Smooth, erect, 1-2 ft. high, from a deep-seated fleshy root: radical and lower cauline leaves ternate, on petioles 2-4 in. long; leaflets linear-lanceolate, entire, 1-3 in. long, upper leaflet more or less distant; upper cauline leaves gradually reduced to bracts: peduncles 2-6 in. long; rays 8-10, glabrous; involucre of one or two bracts, or wanting; involucels of 2-6 linear bractlets; flowers white or pinkish: calyx-teeth prominent: fruit ovate to oblong, $1\frac{1}{2}$-2 lines long; carpel with 5 slightly prominent equal ribs; oil-ducts 2-4 in the intervals, 6 on the commissural side; seed-face more or less concave: purple styles recurved in fruit, with conical stylopodia (figs. 73, 74).—Damp meadows, Bear Valley, San Bernardino Mts., California, August, 1882, *S. B. & W. F. Parish*. This is 987 Parish in part, and was detected in Mr. Martindale's collection. The original specimens under this number were collected in the San Jacinto Mts., in June, 1881, and were distributed as *Carum Gairdneri* Benth. & Hook., but are probably *C. Kelloggii* Gray. In 1882 specimens were collected in Bear Valley, San Bernardino Mts., and referred to the same number, and so distributed. All of this latter collection is the very distinct new species described above. Mr. Parish writes that the species is very abundant in Bear Valley, but is quite inaccessible, and that his specimens of it have mostly been distributed among European herbaria.

stylopodium small or wanting (figs. 69, 70). *Zizia integerrima* DC.—Rocky hillsides throughout our range. Fl. May.

2. **P. Saxifraga** L. var. **major** Koch. Leaves simply pinnate, with sharply-toothed leaflets: fruit oblong, about a line long, ribs sometimes almost obsolete; oil-ducts 2-3 in the intervals, 4 on the commissural side: seed-face somewhat convex; stylopodium cushion-like (figs. 71, 72).—Along rocky shores of the Delaware river and roadsides near Easton, Pennsylvania, *Thos. C. Porter*. Fl. July to September. This European species has been collected by Prof. Porter since 1877, and is reported by him as well established.

EULOPHUS Nutt.[2]—Fruit ovate, flattened laterally: carpel with five equal slender primary ribs (sometimes very indistinct): oil-ducts large, almost contiguous, mostly 3 in the intervals, 4 on the commissural side: seed-section dorsally flattened, with concave face: stylopodium thick conical (figs. 75, 76). Glabrous perennial from fleshy fascicled roots, with ternately or pinnately compound leaves, involucre and involucels scanty or none, and white flowers.

1. **E. Americanus** Nutt. DC. Mem. Umbel. 69, t. 2. Branching, 3 to 5 feet high: radical and lower cauline leaves large, 1–2-pinnately compound, with leaflets cut into short narrow segments; upper cauline leaves ternate, with long linear entire segments: calyx-teeth prominent: fruit 2-3 lines long (figs. 75, 76).—Ohio to Illinois and Arkansas.

The close relationship between Pimpinella and Eulophus (as here defined) is very evident. The character of deeply sulcate seed apparently fails in E. Americanus, as testified by a very large collection of well-matured fruit from Mr. Bebb's herbarium, which apparently has also supplied many other herbaria. The fruit from the Harvard Herbarium is not perfectly mature, and hence the concave face in a few cases seems slightly sulcate, but the ordinary section of the mature seed is as shown in figure 76, with concave face much as in certain species of Pimpinella. In the western species there is a remarkably deep sulcation, but E. Americanus seems to be most unnaturally allied with them, not only in fruit characters, but in vegetative characters as well. How it is to be separated in generic characters from Pimpinella is what we have been unable to discover, but for the present we have retained the old name.

[2] This generic description is based on E. Americanus, as the western species (E. peucedanoides and E. Texanus) differ in certain important characters.

BUPLEURUM Linn.—Fruit oblong, flattened laterally: carpel with 5 equal very slender primary ribs: oil-ducts present or (in ours) wanting: seed-section dorsally flattened, with face broadly sulcate: stylopodium flat (figs. 77, 78). Plant with simple entire ovate perfoliate leaves, no involucre, involucels of 5 ovate leaflets, and yellow flowers.

1. **B. rotundifolium** L.[3].—Introduced from Europe into fields and cultivated ground, New York to North Carolina and Tennessee.

CHÆROPHYLLUM Linn.—Fruit narrowly oblong to linear, notched at base, flattened laterally, with short beak or none: carpel with 5 equal primary ribs, each of which is subtended by a large group of strengthening cells usually occupying the whole thickness of the thick pericarp: oil-ducts small, mostly single in the intervals, two on the commissural side: seed with more or less deeply sulcate face: styles short (figs. 79–84).—Annuals in moist ground, with ternately decompound leaves, lobed or toothed leaflets, usually no involucre, many-leaved involucels, and white flowers.

1. **C. procumbens** Crantz, Umbel. 77. More or less hairy: stems slender, spreading, 6 to 18 inches high: fruit (in the type) narrowly oblong, glabrous, contracted but not tapering at the summit; intervals broader than the ribs: seed-face deeply sulcate (figs. 79, 80).—New Jersey to Iowa and southward to North Carolina and Mississippi. We consider this polymorphous species to include all our forms of Chærophyllum. The only characters that can be used to separate them specifically must be drawn from the beaking of the fruit, the size of the ribs, and the depth of the sulcus in the seed-face. Isolated specimens can be selected which seem distinct enough in these particulars, but a study of a great number of specimens from all regions shows an inextricable running together, and it seems impossible to draw specific lines. Characters that have been used to define species are found displayed on the same plant. Owing to intergrading forms even varieties can not in all cases be distinctly set apart, but the following extreme forms may, in most cases, be distinguished from the specific type by means of mature fruit:

Var. **Shortii** Torr. & Gray, Fl. 1. 637, has more broadly oblong to ovate fruit, not at all contracted at the summit (fig. 81; section as in fig. 80).—Kentucky to Louisiana.

[3] *B. protractum* Link, which differs from B. rotundifolium chiefly in its tuberculate fruit, has been collected on ballast ground by Mr. Martindale.

Var. **Tainturieri** has fruit tapering at the summit or beaked, ribs very prominent and much broader than the intervals, and seed-face with a shallower sulcus (figs. 82, 83). *C. Tainturieri* Hook.—From Florida to Texas.

Var. **dasycarpum** differs from the preceding variety in having pubescent fruit, with ribs prominent but narrower than the intervals (fig. 84; surface outline as in fig. 82). *C. Tainturieri* var. *dasycarpum* Hook.—Texas. This is Hall's 260, "pubescent form," and Lindheimer's 616.

ANTHRISCUS Hoffm.[1]—Fruit linear, notched at base, flattened laterally, long beaked (in ours): carpel without ribs, but beak ribbed: thin pericarp with no strengthening cells nor oil-ducts: seed with sulcate face (figs. 85, 86).—Resembling Chærophyllum in vegetative characters.

1. **A. Cerefolium** Hoffm.—Mature fruit smooth and shining. *Chærophyllum sativum* L.—Naturalized in Eastern Pennsylvania, *Thos. C. Porter.*

EXPLANATION OF PLATE IX.—Fig. 69, fruit of Pimpinella integerrima; fig. 70, section of carpel of same; fig. 71, fruit of P. Saxifraga, var. major; fig. 72, section of carpel of same; fig. 73, fruit of P. Parishii; fig. 74, section of carpel of same; fig. 75, fruit of Eulophus Americanus; fig. 76, section of carpel of same; fig. 77, fruit of Bupleurum rotundifolium; fig. 78, section of carpel of same; fig. 79, fruit of Chærophyllum procumbens; fig. 80, section of carpel of same; fig. 81, fruit of C. procumbens, var. Shortii; fig. 82, fruit of C. procumbens var. Tainturieri; fig. 83, section of carpel of same; fig. 84, section of carpel of C. procumbens var. dasycarpum; fig. 85, fruit of Anthriscus Cerefolium; fig. 86, section of carpel of same. Figs. 75, 79, 81, 82 are ×4; figs 69, 71, 73, 77 are ×7; fig. 76 is ×20; figs. 70, 72, 74, 76, 78, 80, 83, 84 are ×36.

BRIEFER ARTICLES.

Fasciation in Sophora secundiflora (with plate X.)—Dr. A. Schlottman, of Round Top, Tex., several years ago, sent me specimens of a curious form of fasciation in *Sophora secundiflora* Lag. (*S. speciosa* Benth.) It is an evergreen shrub or small tree indigenous to Texas. The specimens alluded to are from a tree which Dr. S. has in his garden, and which annually produces peculiar deformity of the flowering branches or racemes.

The extremity of the twigs, or racemes, become flattened and enlarged, gradually expanding and dividing toward the apex—sometimes in a few, often into a large number of segments—the surface studded with small scales and mostly dormant buds. Sometimes, however, these buds

[1] *A. sylvestris* Hoffm. has been collected by Mr. Martindale on ballast ground.

develop into more or less perfect flowers. I send you a figure which illustrates the appearance of one of these peculiar forms The shrub flowers very early in the spring, and ripens a short, thick pod, containing from one to three large red seeds, called Indian beans, which are said to be poisonous to children, who sometimes eat them.

Mr. J. H. McArthur writes: "Our Angora goats browse freely on the shrub, and frequently swallow the beans without ill effects, but that may be owing to these being too hard for their teeth to crack, as they are found about the pens, having passed through them unbroken."—GEORGE VASEY.

Thalictrum purpurascens, var. ceriferum, in North Carolina.—Though this species of Thalictrum is not mentioned in Chapman's Flora as occurring in the Southern United States, nor in Curtis' "Catalogue of the Indigenous and Naturalized Plants of the State of North Carolina," yet I have found several plants of the variety ceriferum growing luxuriantly on rocks at Flat Rock, Henderson county It grows to the height of five feet and agrees in all respects with the description given on page 39, Gray's Manual, the fruit and leaves being covered with "waxy atoms" and "exhaling a peculiar odor;" it was in full flower May 24th.—E. R. MEMMINGER, *Flat Rock, N. C.*

Dry weather foliage of the Compass plant.—This immediate section of country has been subjected to a prolonged and severe drouth. There has been not far from one inch of rainfall since the last snow-storm of early March. In addition to this we had a very dry summer and autumn last year, so that the rainfall has been unusually light for a whole year. Nearly all wells that never fail in ordinary seasons are now dry, and the college campus exhibits the strange appearance of a brown and apparently lifeless turf studded with dwarfed red clover plants which are in feeble bloom. The leaves upon trees and shrubs are fewer than usual and much reduced in size.

There are a few kinds of plants that seem to flourish under the peculiar arid conditions which now obtain; but even these are somewhat changed in their general appearance. The foliage of the compass plant (*Silphium laciniatum* L.) is particularly noticeable at this time. The leaves of this composite have a strikingly refreshing glossy green which is in sharp contrast with the surrounding dwarfed and dried herbage. But when the foliage is compared with that of its own species, in former years, a great change is seen. There may not be very much difference in the relative size of the leaves of this year with those of last season, but they are more numerous, and each leaf exposes far less surface to the hot, drying sun. In short, the average leaf of this Silphium is reduced to the midrib, with a thin web of green tissue upon each side, and its many lateral veins and their sub-veins bearing narrow ribbons of pulpy tissue. In other words, the foliage, true to the specific name, is very

thoroughly slashed or laciniated. A protracted search was rewarded by finding only two leaves which exhibited the broad and comparatively simple blade so frequently met with in ordinary seasons. There are some plants which grow in a grass field near a walk frequently passed over by the writer, and these have been watched for the last two years. These same plants have now pronounced twice pinnately parted leaves which last year and in 1885 produced several radical leaves, with broad surfaces interspersed with the "holes" or vacant places in the laminæ so familiar to every botanist in the west.

There is also a difference in the position which these much laciniated leaves assume. They are numerous; without the rigidity of normal leaves, and assume a curved or drooping attitude. More than this, they curve outward and downward about equally from all sides of the centre of the plant. In other words, in the present condition of the plant there is very little indication of polarity, and the weary traveler over the dry and scorching prairie would now find a better guidance by noting the positions of the unclouded sun than to try to gain his "reckoning" by relying upon the compass plant. – BYRON D. HALSTED, *Botanical Laboratory, Ames, Ia.*

Course of study in Fungi.—After several years of changing and experimenting, the course in the study of fungi at the University of Michigan has taken its present shape, which is substantially as follows:

The class, having already studied botany for a year or more, are familiar with the leading facts of vegetable histology, and have made a careful study of one or more typical representatives of the great classes of plants, both cryptogamic and phanerogamic, and have also done enough work in systematic botany to be able to identify species readily. Moreover, as the course can not be elected until after one or two years have been spent at the university, those who pursue it have already acquired some knowledge of French and German, and are expected to read in both those languages selections from the most important modern literature of the subject.

The first thing aimed at is to secure a reasonable degree of familiarity with the group as a whole. Notes are given on the Peronosporeæ, Uredineæ, Ustilagineæ, etc., and specimens examined in a cursory way, so that their general appearance, the hosts on which they occur, and such other general facts as are most essential to be known at the outset, are easily acquired In connection with this class work, about ten hours a week are spent in the laboratory in identification of species. Sets of ten species each, put up in envelopes, are handed to a student, and at the end of a week or two he reports upon them. The envelopes are marked on the back like this: No. 1. On Capsella Bursa-pastoris, Ann Arbor, May 21, 1887. No. 2. On leaves of cultivated peach, Ann Arbor, June 3, 1886, etc.

The student makes a microscopical examination of the specimens, writes out notes and makes sketches, and by the aid of monographs. Ellis' sets of fungi, and such other help as he can get, determines the species. The class this semester have already indentified about sixty or seventy species, and as these are selected so as to embrace representatives from the leading groups, considerable knowledge of the subject is gained even in a few weeks' time. Each student is meantime required to prepare an essay on a given subject, which is read and criticized before the close of the semester. One of these subjects given this spring reads: The Uredineæ, their life-history, with special reference to the question of heterœcism, together with an enumeration of the parasitic species that are of economical interest. In preparation for this, the student, to whom it was assigned, read largely and intelligently from de Bary, Schröter, Farlow, Hartig, Ward and other authorities.

By the time the work thus outlined has been accomplished the spring has advanced far enough to enable us to make collections, and an excursion is made every week, resulting in the collection, each time, of from one to six or eight species of parasitic fungi. We are gathering no others at present. Yesterday afternoon we gathered Synchytrium Anemones, Peronospora pygmæa, Puccinia fusca, Æcidium podophyllatum and Peronospora Ficariæ, and examined hosts for others that the class are to keep on the lookout for. The specimens obtained in this way are carried to the laboratory, identified and labeled.

In addition to this, each one in the class is doing a special piece of independent work. One is working out the histology of the common cedar apple, and another is comparing the normal peach leaf with that distorted by the Ascomyces deformans. They will spend the rest of the semester on this special work and on the collection and identification of the species gathered in our weekly trips.

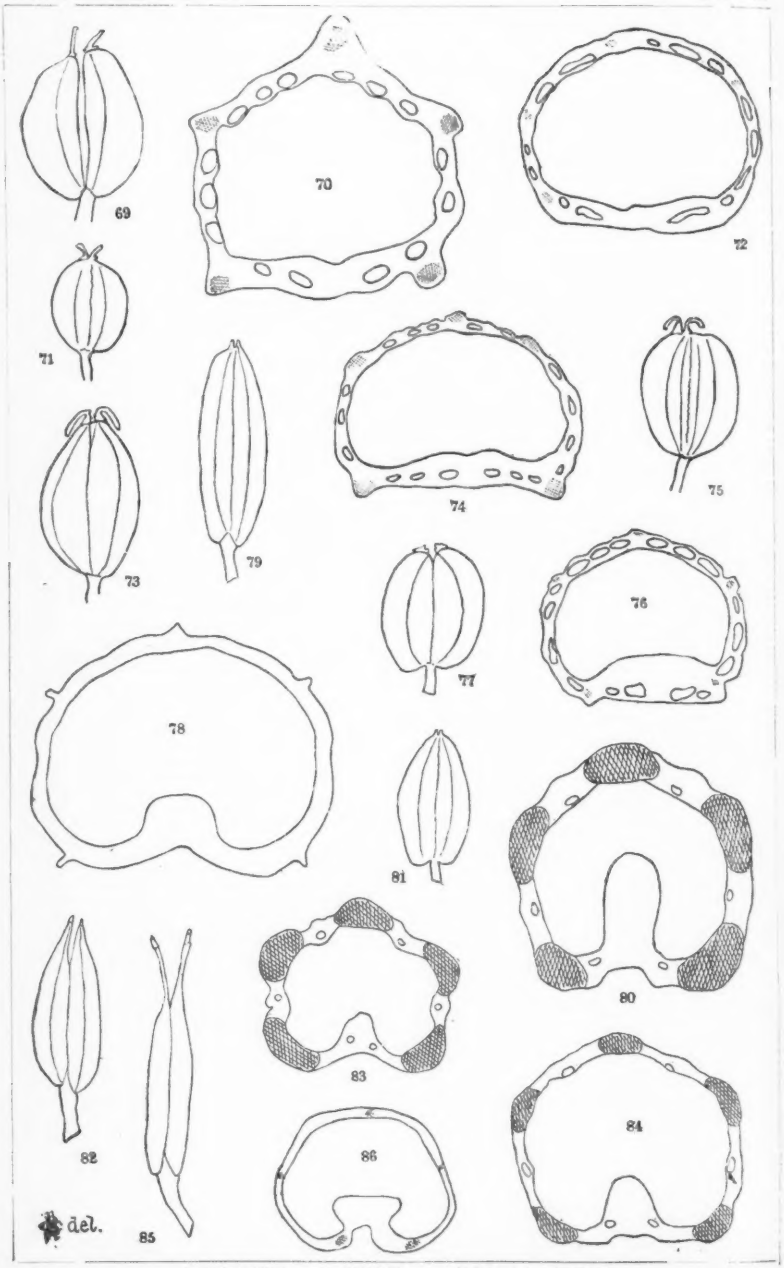
There are only two students in this class. The whole number of students pursuing botany at the university this semester is about two hundred, but the course described above is carefully hedged about with requirements, so that none get into it who are not capable of doing thorough work and a good deal of it.—VOLNEY M. SPALDING.

EDITORIAL.

IN THE July number of *Popular Science Monthly* Dr. Farlow has a paper entitled "The Task of American Botanists." It is to be expected that such a subject and such an author would supply something both interesting and valuable. It touches upon a point of vital interest with scores of willing workers who are anxiously seeking an answer to the question, "What is there for me to do?" Of course, the question is difficult to answer, but never hopeless. The chief difficulty lies in the re-

strictions the young botanist has thrown about the answer. He must have something apparently difficult, far-reaching, exhaustive—a great subject in which he is to become an authority. Such answers are impossible, and young botanists searching for some life work must understand that they are trying to begin at the possible end of their life-work rather than at its beginning. Beginnings are always small and the subjects simple, and the botanist can not expect to begin a great work off hand; he must grow into it. The law of development in the ability of the worker and slow accretions in the range of his subjects may eventually work out to an authority and a great subject. The thing to do is the thing that can be done; and it is not only folly, but a waste of time, to sigh over lack of opportunity for great work. Dr. Farlow concludes that advanced systematic work must be done by experts having access to large collections and libraries; that physiological work of high grade can only be done at a few well-equipped laboratories; but that histology and the study of life-histories furnish subjects for every worker, whatever his locality or equipment. It must be understood that we are speaking of advanced and critical work; for every one interested in botany can furnish valuable assistance in systematic work in the way of collections and field notes. Another difficulty may be mentioned, and that is the unselfishness of good work. Patient, laborious work over details, which is the foundation upon which our science must rest, does not bring the public acknowledgment, the fame, which some superficial work may. A fairly good compiler may step at once into a certain kind of prominence, while a far superior botanist may work all his life in comparative obscurity. It needs a philosophic spirit to work patiently under such conditions. But no botanist has ever begun with the simple problems at his hand, and thoroughly mastered them, who was not led into a wider field, and soon found waiting for him more work than he could ever hope to do.

BOTANISTS are to take it for granted that they will be well entertained at New York next August. Apart from the single fact that the Torrey Club is to be responsible nothing has been published; but this perhaps, is enough. The main thing is for the botanists to get together, and their meeting can not help being pleasant and helpful. Heretofore it has been difficult to get time enough at convenient hours for the meetings of the club; for the informality breeds a desire to speak, and the meetings have always been too short. With such a wealth of attractive places for collecting near at hand as New York affords, there will be a great temptation to overdo the excursion business. As we take it, the average botanist does not care to do much collecting upon such an occasion. He can do that at any time, in person or by exchange. What he chiefly wants is to have a sociable time with his fellows, and for this an excursion is a good excuse. The Torrey Club, with wise foresight in this particular, has arranged to distribute prepared specimens to those desir-



COULTER and ROSE on UMBELLIFERÆ

ing them; so that, while it takes away the ostensible object of the excursion, it leaves more time for the real one. It is to be hoped that this will be one of the largest and most memorable meetings of botanists we ever have had, and that the result of their meeting will be an additional stimulus to botanical work in all departments.

OPEN LETTERS.

Australian alpine plants.

In reading the "Notes and News" of the last number of the BOTANICAL GAZETTE I was led to recall a paper published in the Proceedings of the Linnean Society of New South Wales, August 23, 1886, by J. Stirling. It consists chiefly in a review and a farther account of evidences of glaciation shown in the higher mountains of the Australian Alps (S. E. Australia.) The culmination of the ice-clad period is supposed to have taken place in later Pliocene or Pleistocene times. He refers to the close relationship which the flora of those mountains presents to that of Tasmania, and that "many species found there (in the Australian Alps), between 2,000 and 5,000 feet, have a wide range, recent researches in the flora of Morocco, in Africa, and on that of Rurum Valley, Afghanistan, having disclosed the presence of numerous species of plants common to the Australian Alps." He then refers to Hooker's remark in his Australian Flora that a cooled atmosphere in intertropical regions corresponding to the glacial epochs of the temperate zones might account for the presence of European and arctic species in antarctic and south temperate zones. It seems to me the character of the mountain flora also would find its explanation here.

AUG. F. FOERSTE.

Granville, Ohio.

White and yellow poplars.

While collecting specimens of our so-called poplars (Liriodendron Tulipifera) this spring I called the attention of an intelligent and observant farmer of Lincoln County (Geo. P. Bright) to the following extract from the June ('86) number of *Drugs and Medicines of North America:*

"*Varieties.*—That there are two forms of the tree, distinguished by the amount of heart wood, was early noticed by lumbermen, and that they are distinct can not, we think, be refuted. Marshall mentions them as early as 1785. Michaux distinguishes two forms with acute and obtuse leaves, which he distinguished as var. acutiloba and var. obtusiloba; and Rafinesque states that the acute-lobed form produces the white wood and the obtuse-lobed the yellow wood. Late botanical writers, however, take no cognizance of these forms; and, while we are convinced that there are certainly two distinct trees, as far as the color of the lumber is concerned, we have not been able to determine that they have different shaped leaves. From an observing farmer (Mr. Thomas Rouse, Crittenden, Ky.), who claims to know the two trees apart by the appearance of the bark, we learn the following: 'The yellow poplar grows

along streams and seems to select a damper location than the white, and the trunk is almost entirely yellow or heart wood, there being but a couple of inches of sap wood on the outside. It is very easy to split, makes good rails, and the lumber lasts a long time. The white poplar grows on hilly woods and dry locations, and the trunk is mostly white or sap wood. It is very difficult to split, and decays in a few years, so it has but little value as a timber.' He states that the young trees can not be distinguished, to his knowledge, by the bark, but that the yellow poplar bark of old trees is in long, horizontal ridges, while the white poplar bark is short and choppy."

Mr. Bright has had a large amount of timber cut off his place, and has handled a large amount of "poplar" lumber. He tells me that he is satisfied that the "white" and "yellow" trees are not different varieties, but different conditions of the same variety at different ages. On a high ridge, quite dry, on his place, he has a poplar wood which he has been cutting out; all of the old trees are yellow, the young are white. In a creek bottom near by, which is occasionally flooded, there is an abundant growth of young white trees. He can not tell the color of the wood from the bark. He mentions a tree in front of his house which his father remembers, some forty years ago, as a white poplar tree. Some two years ago the tree was spilt open by lightning, and the wood—excepting two inches of sap wood—was yellow. It had changed yellow as it grew older. Even in the young trees the heart wood is yellow. I have not been able to find any difference in the appearance of the bloom or leaf. Mr. Bright's idea seems to be a very reasonable one, and is founded on observed facts.

H. A. EVANS.

Lancaster, Ky.

Oxalis.

Mr. Thomson's note on autumnal blooming of Oxalis violacea relates to a well-known peculiarity of the plant. In the *American Naturalist* for January, 1882, I called attention to the constant absence of the mid-styled form from this, which should be a trimorphic species. Aside from a figure in Payer's Organogénie, and a record of one doubtful specimen in Hildebrand's paper on "Heterogone species of Oxalis," there is no evidence that this form has ever been observed. I shall be greatly obliged for specimens from any part of the country showing this form of flower—with the pistil intermediate in length between the two sets of stamens.

In going over a very full line of specimens, last winter, I discovered that our flora includes two species of the violacea group that have not been previously distinguished, viz.: O. latifolia, var. and O. divergens, both of which are Mexican species which have extended into our territory. It may be of interest to add that Dr. E. Palmer's Mexican collection of last year includes the rare O. Hernandezii, a plant related to our O. decaphylla, but distinguished by its narrow, entire, hairy leaves.

The most interesting result of this examination, however, is the discovery that we have two trimorphic yellow flowered species of the corniculata group. One of these is the O. recurva of Elliott, a perennial with creeping rhizomes, dark-bordered leaflets, and large flowers (as compared with O. corniculata or its variety stricta), which occurs from North Carolina to Pennsylvania and Ohio. The other, an Oregon species, which has been confounded with forms of corniculata, I have called O. Suksdorfii, in a paper presented to the Boston Society of Natural History some months ago. It is lower than O. recurva, and destitute of the

dark borders to the leaflets, but otherwise closely related to it. Both are clearly distinct from O. corniculata and its variety stricta, although each of these in some localities produces rather large flowers resembling the long-styled form of a trimorphic species. A repent southern and Californian form, which I have called O. corniculata, var. (?) macrantha, appears as though it might prove to be trimorphic. I shall be greatly obliged for specimens and accurate measurements of the floral organs of this plant that may throw light on this point. WILLIAM TRELEASE.

St. Louis, Mo.

A walnut sport.

J. R. Johns, Millersburg, Pa., sends an abnormal walnut, the appearance of which, he thinks, is due to pollen of the hickory. Similar nuts have been found at about the time of the first frosts in the fall, for four successive years, at about the same spot under a black walnut tree—about a dozen specimens in all. The nearest hickory tree is about 800 yards distant. "That the nut is part hickory and part walnut," he says, "can not be doubted by any one seeing it in the first state. The lower or walnut part of some was more fully developed than in the specimen forwarded."

The nut is mature, of nearly the size of an average walnut, and has its lower third seated in an adherent, two-lobed, cup-like body, in texture much like the outside of a walnut. The "shuck" of the upper part is thinner and smoother than usual, and still shows the four parts of the adherent calyx as when young, thus causing it to resemble a hickorynut. On cutting it open the shell and kernel were found to be those of the walnut. The lower adherent portion is possibly the persistent bract.

Dep't of Agriculture, Washington, D. C. A. A. CROZIER.

Preventing fertilization.

Dr. Halsted, in a recent bulletin of the Iowa Agricultural College, gives the result of some experiments on excluding pollen from squash and cucumber flowers. They were undertaken to demonstrate to his students the necessity of the pollen for the development of the fruit. The pollen was excluded by covering the female flowers with cloth sacks.

I have found other ways of excluding the pollen to answer the purpose. Five female cucumber flowers nearly in blossom, on plants growing in dry sandy soil, were each covered with paper and then each with a hoe full of earth, the places being marked by stakes. In eight days one was dead, three were yellow and one still green. All finally died after making a small amount of growth. Some other young cucumbers, covered just after the blossoms had withered, all developed. The temporary covering of dry sandy soil did not seem to affect their growth, and the paper was not considered essential.

Another method was tried with some muskmelons. Five pistillate flowers nearly in blossom were clipped off with scissors just at the top of the ovary. Five others on which the flowers had faded, and which were presumed to be fertilized, were clipped in a similar manner to determine whether any failure of the first set to grow might be due to injury by the cutting. All the first set died, the young fruits growing less and dying sooner than in the case of the cucumbers. All those clipped after the blossoms had withered fully matured, except one which the chickens got at. A. A. CROZIER.

Agricultural Dep't, Washington, D. C.

CURRENT LITERATURE.

Little Flower-People. By Gertrude Elizabeth Hale. Boston: Ginn & Co., 1887. 12°. pp. 85. Illustrated.

Here is a book to be commended, both for what it attempts to do and for what it really does. The author wishes to interest children in some of the elementary facts of scientific botany. To do this she personifies the chief organs of the plant and relates how these several members of a household assist one another and the results they bring about. Thus each flower is a mistress attended by leaf, stem and root servants, and by the activity of the servants the life and perpetuation of the plant is assured.

The literary part is well done, the botanical part irreproachable (to be said of but few children's books), and the child that can read *St. Nicholas* or *Wide Awake* with profit will find interest and instruction in this pretty volume. The amount of serviceable knowledge, overspread with a thin veil of fancy, is really astonishing, and herein lies the danger; for if the child is left entirely to himself it may happen that now and then he will find thought and language beyond his grasp.

A Primer of Botany. By Mrs. A. A. Knight. Boston: Ginn & Co., 1887. Sm. 12°. pp. 115. Illustrated.

Sachs' Text-book and Bessey's Botany boiled down for babes! That is the way it strikes one upon first looking into this work; and every prejudice against so preposterous an idea is at once aroused. But our fervor is somewhat abated when we find in the preface that the author has considered the matter from this very point of view—"as if one should read Spenser in the nursery," she says. An unbiased examination of the work, we feel sure, will convince most teachers that Mrs. Knight has really performed an excellent service.

In the first place the book is not to be put into the hands of the pupil, but is only to be used by the teacher as an outline of the subject and of the method of its presentation. Moreover, the teacher must already know botany from previous study—not the botany of the usual high school course, but that of the laboratory—the botany in which the one-sixth objective glass is no greater hindrance than the common hand magnifier, and pond scum, mildews, mushrooms and lichens are as well understood objects as trees and flowers. Presupposing this much knowledge on the part of the teacher, the possession of a good compound microscope and a moderate allotment of time, the successful teaching of pupils, who find "protoplasm" a big word to spell and remember, will depend largely upon the tact of the teacher.

Nearly fifty pages of the book are devoted to the microscopic structure of plants, as much more to physiology, and the remaining twenty pages to the plant body, the distribution of plants, and the use and care of the microscope, the last subject being treated by Mr. G. N. Cross.

VASEY on FASCIATION.

It would be downright folly to teach these subjects to children, if every step is not fortified by clear observations and experiments, for which the work provides. The book is so constructed that rote teaching is, indeed, well nigh out of the question. The limited number of well qualified teachers will restrict its use more than the inherent difficulty of the subject.

A number of errors and oversights seems to be the rule in works of this class, to which the present one is no exception. On p. 16 the pericarp of the peach and apple is spoken of as the seed coat. There appears to be a misconception of the limits of the epidermal system, especially conspicuous on p. 24, and also of the significance of the term, "growing point," which is made frequent use of. On p. 50 water is not recognized as a part of the food of the plant, although the way the plant makes use of it as a food is described on p. 53.

Elements of Botany; including organography, vegetable histology, vegetable physiology and vegetable taxonomy, and a glossary of botanical terms. By Edson S. Bastin, A. M., F. R. M. S., professor of botany, materia medica and microscopy in the Chicago College of Pharmacy. 8°., pp. xv, 282, figs. 459. Chicago: G. P. Engelhard & Co. 1887.

Botanical text-books are coming thick and fast. It is one of the signs of the times which indicates that botany is taking its proper place among the sciences which ought to be taught. This book is a welcome addition to the list. It does not pretend to exhaust the subject; it does state fairly and clearly the *elements* of botany. The order of presentation is good, and well adapted to the needs of a large class of students. Part I (106 pp.) treats of the various organs of the higher plants, and covers essentially the same ground as Gray's Lessons. Part II (62 pp.) gives a brief account of the cells, tissues, tissue systems of plants and their arrangement in the several organs. Part III (27 pp.) contains a condensed treatment of the functions of plants. Part IV (55 pp.) explains the classification of plants on the same system and in very much the same style as Bessey in his well-known text-book. To each chapter in parts I and II is appended a series of directions for practical study which are specially commendable. Why are they not also found in part III? This physiological portion might have been doubled in extent with great profit to students, as some important topics are omitted, or too briefly treated to be comprehensible.

The book, as a whole, is comparatively free from errors, which is a great point in its favor. It is attractively written, and everywhere exhibits a strong pedagogic spirit. Some unfortunate typographical errors have been overlooked which should be corrected in another edition. The chief fault we have to mention is the illustration. The figures, the author states, were drawn by his own hand to insure accuracy. We have no criticism upon their accuracy (with very few exceptions), but the *quality* of the majority is not at all in keeping with the beautiful text.

This is partly the fault of the printer, partly of the engraver, and partly of the artist. A judicious weeding out of the bad ones would greatly improve the appearance of the book, and remove the possibility of giving a poor impression at first sight.

We heartily commend the book to the attention of teachers as one likely to prove suitable for class use, and as one which is well up to the times, fresh and vigorous.

NOTES AND NEWS.

DR. N. CONR. KINDBERG describes a new Cinclidotus from Greece, *C. falcatus*, in the *Rev. Bryologique*, No. 3, 1887, p. 43.

DR. P. FALKENBERG has been appointed Professor of Botany and Director of the Botanical Gardens at Rostock, and Dr. August Gravis to the same offices at Lüttich.

MISS EFFIE A. SOUTHWORTH, for some time past instructor at Bryn Mawr College, is now connected with the Section of Vegetable Pathology at Washington, chiefly engaged in microscopical work.

MISS HELEN DE S. ABBOTT, known to our readers by her studies in botanico-chemistry, has been elected a member of the Philosophical Society of Philadelphia, being the sixth woman who has received that honor during the society's six score years of existence.

PROF. F. L. SARGENT has been obliged, on account of failing health, to resign the chair of botany in the University of Wisconsin. His work there is highly spoken of. Prof. C. R. Barnes has been called to the place, and will remove to Madison early in September.

DURING THE ABSENCE in Europe of Prof. W. R. Dudley, of Cornell University, who sailed from New York June 25, his classes and other college duties will be cared for by Mr. F. V. Coville, who has just been graduated from the university with special honors in botany.

GREVILLEA for June has the following note under the heading, "Waste Paper:" "Our readers should look out for another new book which professes to be a 'field book for fungus hunters,' but is really only a hunter for their spare coppers. 'Please pity the poor blind.'"

THE FOURTH PART of Th. Fischer's *Bibliotheca Botanica* is a work by Dr. Herman Vöchting, entitled, "Die Bildung der Knollen." Two other parts are in press, Dr. S. Dietz, on Blüthenentwickelung von Typha und Sparganium, and Dr. Aug. Schenck, on Fossile Pflanzen aus der Elburskette.

THE SECTION OF VEGETABLE PATHOLOGY of the Department of Agriculture, under the management of Prof. Scribner, has established three stations for testing fungicides, especially for the treatment of the diseases of the vine. They are at Fayetteville, N. C., at Charlottesville, Va., and at Vineland, N. J.

THE SOCIÉTÉ MYCOLOGIQUE DE FRANCE has just published the first part of its third volume. It is chiefly devoted to an account of the several meetings of 1886, and also has a paper on edible fungi, with excellent illustrations, partly photographs and partly colored plates, and a paper regarding the Discomycetes in an inedited work by Dunal.

MR. ERWIN F. SMITH, government assistant in the study of plant diseases, has been commissioned to investigate the subject of "peach yellows." It is a very obscure but highly important subject, and Mr. Smith will win laurels in the scientific field and receive applause from the cultivator if he discloses the true nature and action of the disease.

MR. L. H. PAMMEL, of the Shaw School of Botany at St. Louis, has distributed a pamphlet, reprinted from vol. xv of the Trans. Minn. Hort. Soc., on the weeds of Southwest Wisconsin and Southeast Minnesota. An account of the prolificacy, vitality, dissemination and migration of weeds is followed by a list of eighty-eight species, with remarks, a table showing the native country of each, and a list of papers consulted. The species are those of the region of La Crosse.

THE SUMMER INSTITUTE at Martha's Vineyard, which holds a five weeks' session beginning early in July, continues its botanical department under the able management of Mr. Edward S. Burgess, of Washington. The courses are graded to meet the requirements of students of varying proficiency, and the methods are those adopted by the best educators. There is provision for special studies in the fresh and salt water algæ, histology, etc. The department of microscopy, conducted by Rev. J. D. King, also gives attention to vegetable histology and to technics.

THE TEMPERATURE of the stems of plants at the surface of the ground is found by Mr. E. S. Goff (*Agric. Science*, vol. I, p. 134) to be greatly influenced by the depth from which the supply of moisture is mainly drawn. As the temperature of the air and of the surface soil rises toward the hottest part of the day, the temperature of the stem remains depressed in direct ratio to the depth of the chief part of the feeding rootlets. In the beet the temperature of the root at four inches below the surface of the ground was found to be practically the same throughout the day as that of the surrounding soil; but at the surface of the ground the stem, on the hottest day recorded, was ten degrees cooler than the soil. Observations on the cabbage, tomato and corn were specially instructive, as they respectively represent deep, medium and shallow habits of root feeding.

DR. OLIVER WENDELL HOLMES takes an interest in trees, and large ones in particular. In a recent visit to England he measured a Scotch elm at Oxford, in the grounds of Magdalen College, as he tells us in the *Atlantic Monthly*, vol. lix, p. 645, that had a girth of twenty-five feet six inches at the smallest part between the limbs and ground. This he contrasts with New England elms as follows: "I have measured a good many of these. About sixteen feet is the measurement of a large elm, like that on Boston Common, which all middle-aged people remember. From twenty-two to twenty-three feet is the ordinary maximum of the very largest trees. I never found but one exceed it; that was the great Springfield elm, which looks as if it might have been formed by the coalescence from the earliest period of growth of two young trees. When I measured it in 1837 it was twenty-four feet eight inches in circumference at five feet from the ground, growing larger above and below."

DR. F. GRAVET has translated from the Danish into French a paper by C. Jensen on the analogous variations of the Sphagnaceæ. The author points out the fact that the interminable variations of these mosses are reducible to certain form-series under each species which are closely analogous. These forms are traced by the author to their external causes as far as possible. Thus plants growing entirely under water exhibit certain peculiarities, and these variations are so similar under the

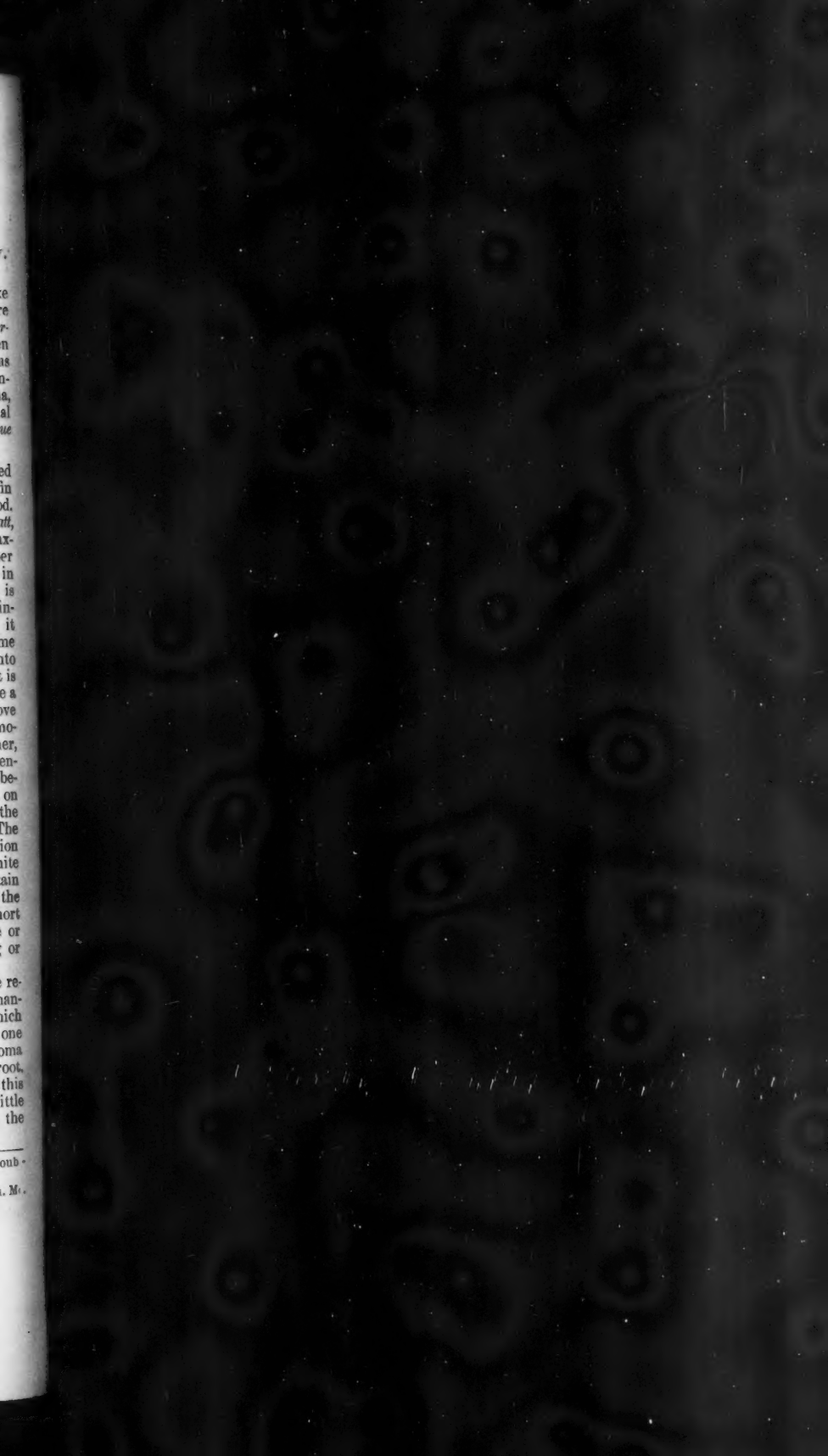
different species that they may be grouped as *formæ immersæ*. In like manner *formæ compactæ et strictæ* are attributed to growth in a place more or less dry where they receive the direct rays of the sun; *formæ squarrosulæ, falcatæ, homophyllæ*, and *tenellæ* are recognized. The author then points out the varieties under each species which may be considered as belonging to the various forms. Mr. Jensen is the first to study the influence of external agents on the formation of the varieties of Sphagna, and his memoir is a very interesting and instructive one. The original appeared in the *Botanisk Tidskrift*, vol. xiii, and the translation in *Revue Bryologique*, vol. xiv (1887), p. 33.

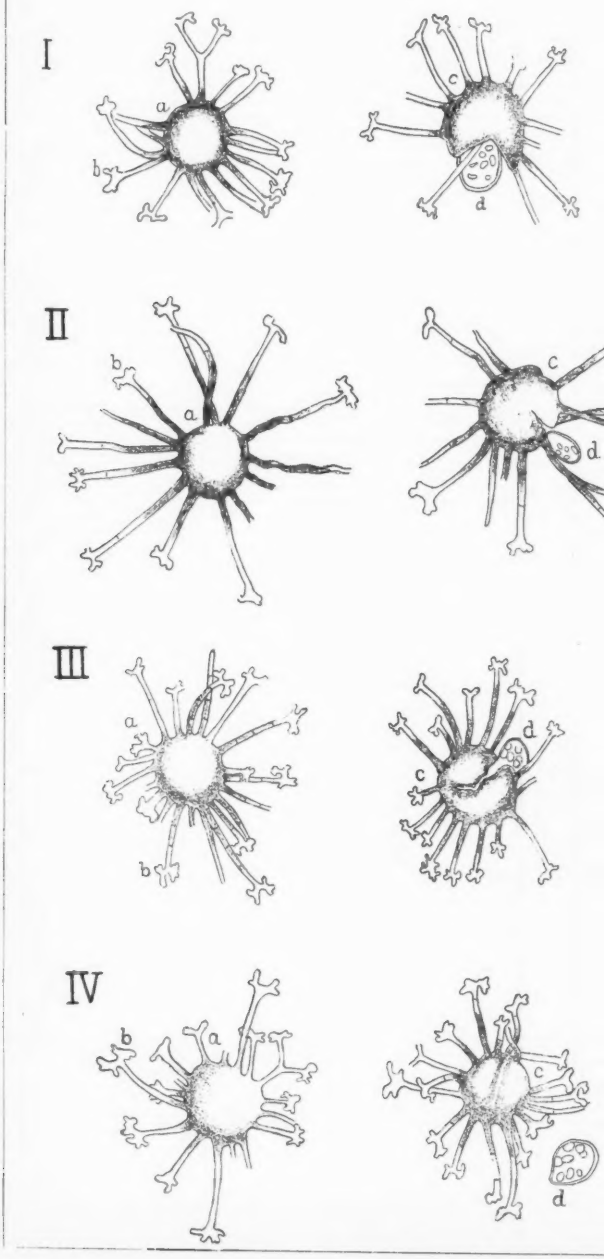
Dr. S. Schönland, of the University of Oxford, claims to have reached the long-desired process of embedding delicate plant tissues in paraffin so that unshrunken serial sections may be cut by the ribbon method. His process is described essentially as follows in the *Botanisches Centralblatt*, vol. xxx (1887), p. 284: The object should be stained entire in borax-carmine, for which twenty-four hours suffices. Then place it in 30 per cent. alcohol, to which a trace of acetic acid has been added, and then in successively stronger alcohol up to the strongest commercial, which is 92–95 per cent.[1] It is next transferred carefully to a small vial (containing 3–4 cm.) of equal parts of clove oil and strong alcohol. At first it will float, but when it has sunk to the bottom, which often takes some time, it should be transferred to pure clove oil, and after an hour into oil of turpentine, in which it must remain about six hours. Finally it is placed in melted paraffin for 8–10 hours. The paraffin used must have a melting point of about 45° C., and its temperature must never go above 47°. For keeping the temperature constant the well-known thermo-regulator must be used. The embedding is done in the usual manner, using either the paper tray or the L-shaped pieces of metal. It is generally best to raise the temperature of the paraffin somewhat shortly before pouring it into the mold, to prevent the formation of bubbles on cooling. The manipulations for cutting the ribbons of sections with the rocking or sliding microtome are the same as with animal tissues. The sections are fastened to the slide with a mixture of one part of collodion and three parts of clove oil, or a mixture of equal parts of filtered white of egg and glycerine. The first is preferable in case one desires to stain the section on the slide, while the latter is generally reliable when the fixing only is desired. The slide is then put in a warm place for a short time or warmed gently over a flame, then plunged into turpentine or flooded with it to dissolve the paraffin. It is then ready for staining or mounting in the usual way.

Those not familiar with the treatment of animal tissues and the requisites for ribbon section-cutting will find detailed accounts in the manuals on histological technique.[2] The author adds that the results which can be attained are almost incredible. In serial sections of leaves one can, not infrequently, obtain four to six sections through the same stoma and it is easy to get several sections through the apical cell of a fern root, when the embedding is rightly done. It will be observed that this method differs little from well-known zoological methods, but that little probably constitutes the difference between success and failure in the process.

[1] Schönland used methyl alcohol, the strongest 92 per cent., but ethyl will undoubtedly answer, and is commoner in this country.

[2] Cf. Whitman "Methods of Research, etc.," Cassino, 1885. H. L. Osborn, in Am. Mon. Mic. Jour., May, 1887.

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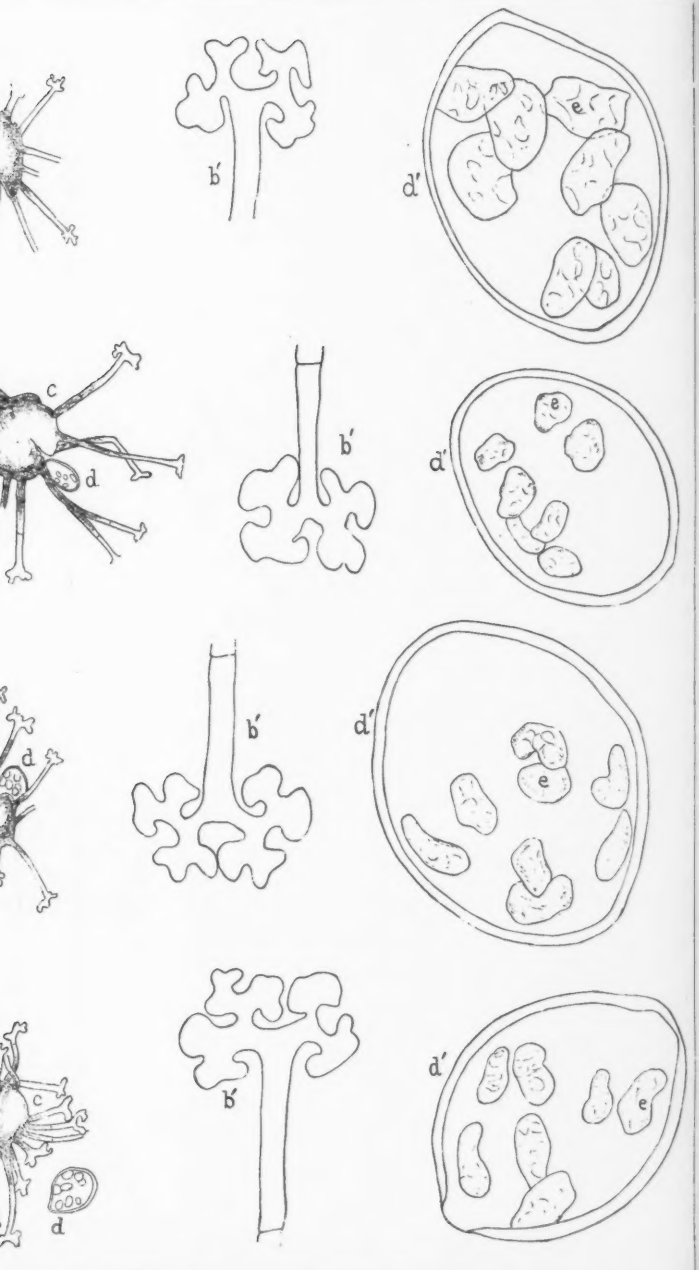

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